IRRIGATION SCHEDULING IN VEGETABLES FOR YIELD IMPROVEMENT AND CROP DIVERSIFICATION

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ABSTRACT

Two field experiments evaluated the amount and frequency of irrigation on bottle gourd and lady's finger at IAAS, Rampur, Chitwan during summer of 1995. Split-split-plot design with two levels of mulch in bottle gourd, and three levels of nitrogen in lady's finger were used as main plot factors. Sub-plot (three frequency levels, FIW) and sub-sub plot (amount of water, AIW) were common factors in both experiments. AIW was determined by amount of water applied to cumulative pan evaporation less the rainfall (IW/Epan) ratio of 1, 0.75 and 0.5.

While the frequency and amount of irrigation had significant interaction effect on the number of nodes of bottle gourd at 0.05% probability level, and significant single effect of mulching on number of primary braches, none of the other treatments could produce statistically significant difference on yield and other yield attributing characteristics of this crop. Although non-significant, the results also indicated that frequent application of higher amount of water could result in reduced water productivity and yield loss in this crop. In the case of lady's finger, however, low level of nitrogen application with low but daily watering had highly significant effect on crop yield. Interaction effect of all factors was also significant on fruit yield that indicated the need to consider the possible increase in return to farmer even by smaller irrigation.

Key words: Vegetable, irrigation, water scarcity, water productivity, return to farmer.

1. INTRODUCTION

Of the several constraints of crop production identified, decreased water availability is the one, the use of which has therefore, to be done in more rationalized and efficient manner than ever before. Therefore, two issues that need attention are a) finding means of lowering the current level of water demand by some efficient water use techniques, and 2) promote economic return to the farmers to enhance economic incentives. These can be achieved through increased water productivity and crop diversification with high value crops in the cropping systems. It is thus important to maximize water productivity by evaluating the functional relationship between crop yields, water use, and timed input of irrigation water for broader soil and climatic conditions. This would help developing more practical irrigation schedules in response to available water supply. Higher water productivity is secured when applied to vegetables than to cereal crops because of market value and increased probability of crop diversity. This is particularly important in Nepalese context where most of the farmers are small holders and are faced with situation of vulnerable food insecurity.

Vegetables in the market experience price hike during off-season. If grown without reliable irrigation supply during dry season they usually succumb yield losses. However, water demand of the crops may be greatly lowered by mulching the crop to conserve soil moisture. This can be an important practical aid in water saving and to minimize the cost on water fee. Furthermore, increased soil-water storage could favor the uptake of nutrients by plant roots.

Rising trend of strong vegetable market during dry/off season and improved nutritional awareness of the people have attracted farmers to bring more area in summer and spring seasons under vegetables in Terai and Inner-terai regions of Nepal. However, dry weather in this season creates condition of water scarcity for many crops that require frequent irrigation. Several studies have reported mulch to conserve soil moisture and improve crop yield (Singh and Gangwar, 1972 and Singh et al., 1976). Likewise the role of irrigation at proper level and stage of plant has great significance in improving the yield (Singh, et al., 1990). Padem and Alan (1992), Gupta (1990), Bandel et al. (1980), and Thomas et al. (1970) reported that judicious application of fertilizers in conjunction with proper irrigation is the principal factors affecting the crop yield.

It is in these premises that a set of two experiments; one, on bottle gourd, and the other, on lady's finger were carried out simultaneously with the overall objective of developing enough information on frequency and amount of irrigation as well as for the assessment of crop response to mulch and fertilizer application for yield improvement and crop diversification applicable to hot and humid agro-ecological conditions with course acid soils of Chitwan, Nepal.

2. METHODOLOGY

The experiment was conducted in the Horticultural Farm, IAAS, Rampur, Chitwan during dry season of 1995. According to soil taxonomy (1975), the soil was classified as Coarse Loamy, Hyperthermic, Micaceous, Typic Haplustoll (Khakuryal, et. al., 1984). Soil samples were collected and analyzed for available nitrogen, organic matter and soil texture.

2.1 Nursery Preparation

Nursery of bottle gourd was raised during March of 1995, used 2-3 seeds/polythene pot 15x12cm in size, and applied equal quantity of well-decomposed and pulverized manure. Seeds were placed at 2 to 5 cm depth in the pots. Regular care and watering was done till the seedlings were ready for transplanting. As lady's finger do not require nursery, overnight soaked seeds were sown directly to the experimental plots on 28-29th of March 1995. Compost was applied @20t/ha before sowing. Regular watering, gap filling and plant protection measures were done as and when needed. *Pusha Summer Prolific Long* –a widely grown variety of bottle gourd, and *Parbhani Kranti* –an improved cultivar of lady's finger were used in these experiments.

2.2 Land Preparation, Transplanting and Cultural Practices

2.2.1 Bottle gourd

The land was ploughed and cross-harrowed three times during second week of March. After layout, pits of size 1'x1'x1' were dug at 2x2m spacing, maintained four plants/plot and kept a gap of 2m in each side of the plot. Area of sub-sub plot was 16m^2. Surrounding the main-plots, border plants were grown to avoid border effect. The manure was mixed with topsoil and basal N, P and K applied @50:60:60 kg/ha, respectively. Seedlings of 25 days old were transplanted during April 5-6, 1995. Gap filling, regular watering and care were done until the plants established well. Nitrogen was top dressed @40 kg/ha 45 days after transplanting.

After establishment of seedlings the plants were mulched with straw on April 28, 1995 in such a way that the area around the plants and the interspaces could be covered with 5 cm thick straw mulch. Irrigation treatments were imposed beginning the same day. Observations were made of pan evaporation and rainfall events daily at 8:00 a.m. The amount of rainfall was deducted from pan evaporation reading to determine the rate of effective evaporation. Since the experiment was conducted during dry season all the rainfall was considered effective contributing to plant water requirement. The irrigation application was terminated on May 15, 1995. Fruit picking started from May 17, 1995 that continued for two months (middle of May to middle of July).

2.2.2 Lady's Finger

The field was prepared by 2-3 cross-harrowing and soil incorporated with well rotten organic compost @20 t/ha about a week before sowing the seed. Basal dose of P and K @40 kg/ha each were applied at the time of sowing. As N was the main plot treatment, basal dose was applied before seed was sown on March 28-29, 1995. The remaining half of N was top dressed 45 days after sowing on May 16, 1995. Each sub-sub plot consisted of 35 plants such that there was 5 rows spaced at 40 cm between two rows and 7 plants/row planted at 20 cm in between tow plants within a row. The net plot consisted of 15 plants while the plants in the periphery of a sub-sub plot worked as boarder plants. Observations were taken from those 15 plants only. Irrigation treatments were started from May 3, 1995 when the plant stand was fairly well and stopped on May 15. On top of regular cultural operations, the plants were top dressed with N-fertilizers on May 16, 1995. Rogor was sprayed on June 7, 1995 to control jassids, because Jassids appeared to be a problem. Fruits were harvested at an interval of 3-4 days and picked 26 times starting from May 16 to July 24, 1995. The yield and yield attributing characteristics of bottle gourd and lady's finger considered for analysis have been shown in Table 1.

2.3 Experimental Design

Both experiments were laid out in split-split plot design in which the factor *amount of irrigation* received the highest precision and the treatments consisted of three levels of amount of irrigation as determined by IW/Epan of 1.00, 0.75 and 0.05. There were four replications of 18 (2x3x3) treatment combinations in bottle gourd, and four replications of 27 (3x3x3) treatment combinations in lady's finger. These sub-sub plot and sub-plot treatments were common in both experiments. However, at the main-plot level, bottle gourd experiment was imposed with *mulching* (straw mulch of about 5cm thickness and no mulch) factor, whereas nitrogen (@30:60:90 kg NPK/ha) was the main-plot factor in the case of the lady's finger's experiment.

Table 1. Yield and yield attributing characteristics of the vegetable crops

Bottle gourd	Lady's finger
No. of fruits	No. of fruits
No. of primary branches	Fruit length
Average fruit length	Plant height
Days to first female flowering	No. of picking
No. of nodes	Harvest size per picking
Main shoot length	Fruit girth
No. of picking	Days to 50% flowering
Harvest size per picking	Yield
Yield	

2.4 Irrigation Scheduling

Irrigation schedule was established by amount and frequency of irrigation. The amount of water to be applied during each irrigation was determined by IW/Epan, the ratio between a fixed amount of irrigation water (IW) and cumulative open pan evaporation (Epan) minus rainfall. This approach was found to be more practical as compared to other methods that are based either on assessment of soil moisture depletion or soil moisture tension. Contrary to these sophisticated techniques, the approach based on IW/Epan has merit due to its simplicity, pragmatic and potential for adoption in the farmers' field.

Three levels of irrigation applied were determined by IW/Epan of 1.00, 0.75 and 0.50 thus accounting the amount of water applied to be equal to Epan, 75% of Epan and 50% of Epan, respectively. As already stated, the application of water was scheduled over three irrigation frequencies: daily, 3 days and 4 days gap between successive irrigations. Calculated amount of water applied is shown in Table 2.

Table 2. Amount of irrigation water applied at three time frequencies

Irrigation Frequency	Water Level	Amount of irrigation water Bottle gourd (ltr/plant)	Lady's finger (ltr/plot)
Daily	IW/Epan =1	73.75	139.94
	IW/Epan =0.75	54.06	102.28
	IW/Epan =0.50	34.53	65.23
Two days interval	IW/Epan =1	71.98	139.38
	IW/Epan =0.75	49.35	102.28
	IW/Epan =0.50	31.32	65.22
Four days interval	IW/Epan =1	73.75	139.94
	IW/Epan =0.75	52.12	96.96
	IW/Epan =0.50	30.35	54.59

The measurement of evaporation (Epan) was carried out daily in "Class – A Evaporation Pan," 120 cm diameter and made of 22 gage GI sheet, installed in the experimental area. The depletion of water level was corrected by multiplying it with a pan coefficient of 0.70 to account for thermal mismatch error. Pan coefficient of 0.70 was used based on earlier findings of Michael (1978) and Prihar and Sandhu (1987) who have found class – A pan reading to be approximately 30% higher than the evaporation from moist soil surface. The measurement of rainfall was carried out using a 8" diameter non-recording rain gauge installed in the experimental area.

2.5 Statistical Analysis

Analysis of variance (ANOVA) was carried out using MSTATC to determine whether yield and yield attributes were significantly affected by the treatments at all precision levels as shown above and presented the test significance at 0.05 and 0.01 probability levels. Least significant difference was computed to compare statistical difference in treatment means. Comparison of treatment means of interaction effect was also made wherever needed.

3. RESULTS AND DISCUSSION

3.1 Initial Soil Fertility and Growing Weather Condition

Although soils are predominantly coarse in texture, chemical analysis indicated that these soils supply crop plants with moderate level of available nitrogen and organic matter (Table 3).

Table 3. Initial soil fertility status of the site

Site	Indicators of residual soil fertility			
	Available N %	Organic matter %	Organic Carbon %	Soil texture
Experiment-1 (Bottle gourd)	0.02	2.62	1.52	Sandy loam
Experiment-2 (Lady's finger)	0.01	2.34	1.35	Sandy loam

Meteorological data were obtained for each day from nearby meteorological station to establish the weather condition during the course of field study. The data included maximum and minimum temperature, relative humidity, and amount of rainfall (Fig.1). The data so obtained was utilized to explain crop water requirement and also to relate the rate of evaporation with the weather condition and the trend thereof.

May being the hottest month, maximum temperature ranged between 30 to slightly above 40° Celsius over the entire growing period. Although April and May showed some fluctuation, June and July were observed to have consistent pattern in terms of both temperature and relative humidity (RH). The RH that was relatively low (around 50%) in April and May increased up to 90% towards June and July. Minimum temperature that increased steadily from as low as 10° Celsius in April to as high as 30° Celsius in the middle of June and remained fairly constant thereafter. Weekly average rainfall that was low (<10mm) in April and May increased abruptly to as high as 40mm and started declining from the second week of July onwards.

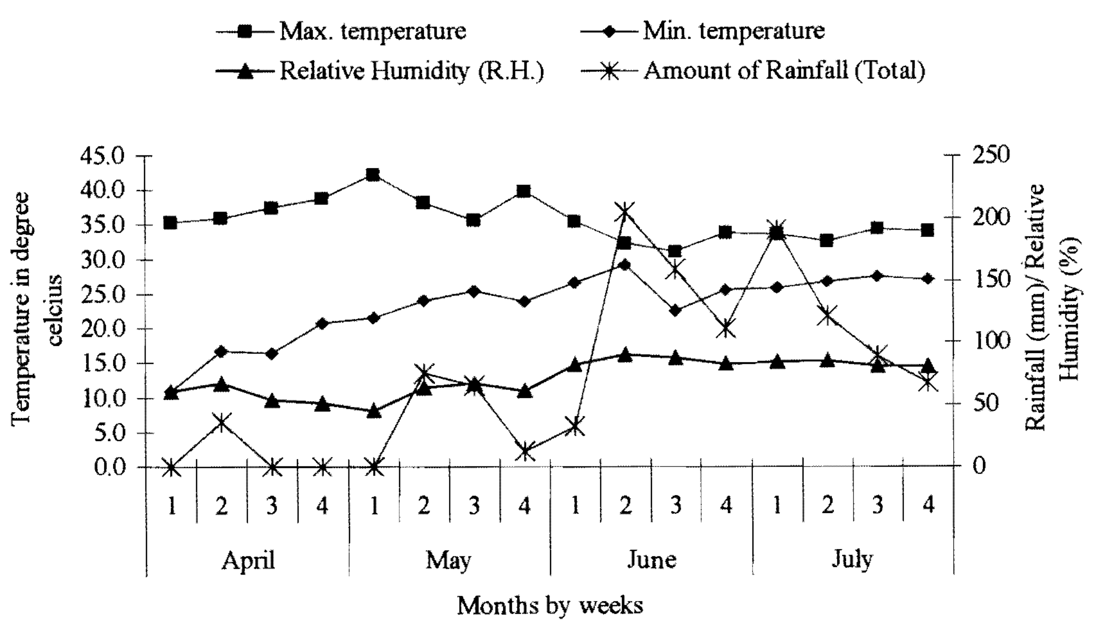


Fig. 1. Weather condition during crop growth period during 1995

When temperature and humidity were on the rise in April and May, rainfall was still low that established a dry weather demanding for water supply to the crops. Beyond this time, although temperature and humidity approached a steady-state, irrigation was halted because of high rainfall pattern that sufficed the crop water requirement in these experiments.

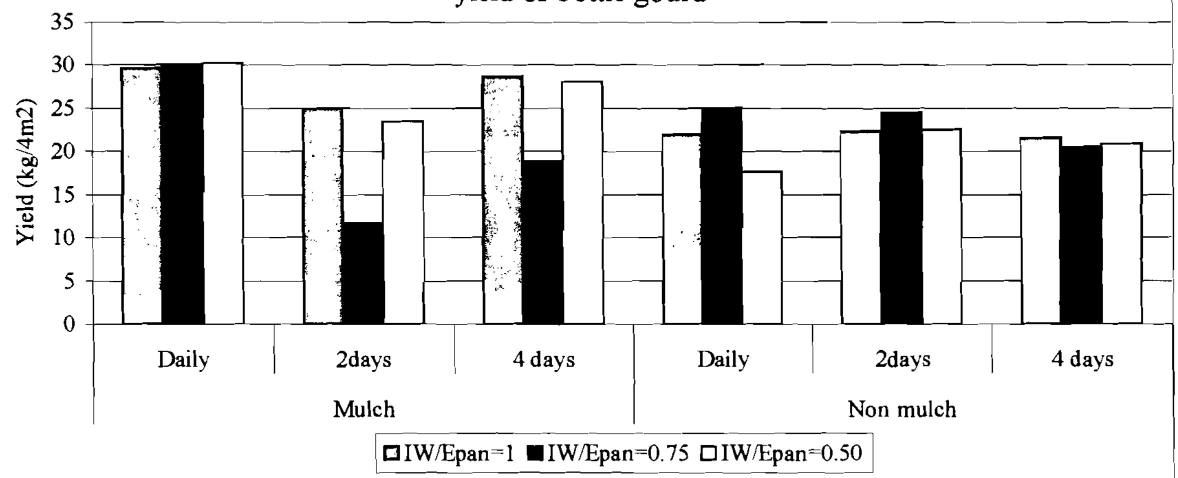
3.2 Performance of Bottle Gourd

3.2.1 Number of Primary Branches, Nodes and Crop Yields

Analysis of variance (ANOVA) indicated that mulching and interaction of frequency and amount of irrigation had significant effect on number of primary branches and on number of nodes, respectively (Table 4 and Annex 1). Interesting to note was that statistically lower number of primary branches (3.25) was observed in mulched plots compared to those (3.47) in plots without mulching (Table 5). While the purpose of mulch is primarily to improve condition for conserving soil moisture under conditions of moisture stress in the soil, the treatment of mulching did not show effect most probably because the plots had received calculated amount of irrigation at least once after every four days gap and the field did not experience condition of moisture stress.

Although non-significant, mulching had favorable effect on most of the other attributes such as number of fruits, fruit yield, number of leaves, days to first female flowering, and main shoot length *(Annex 3)*. Ghorai (1995) had also similar results where straw mulch and irrigation application could not bring significant effect on the yield and yield attributing characteristics of the pointed gourd in similar acid soil. A graphical presentation of relationship of mulching,

Fig.2. Effect of mulching, irrigation interval and amount of water on the yield of bottle gourd



frequency and amount of irrigation with yield of bottle gourd indicated that application of moderate amount of water at wider intervals with mulch might be a better combination (Fig.2). A comparison of treatment means indicated that daily irrigation equal to IW/Epan = 0.75 produced the highest number of nodes/plant, which is statistically higher than others where plots were irrigated at fixed time intervals (Table 4).

Table 4. Comparison of treatment means of interaction effect of irrigation interval and amount of water on number of nodes in bottle gourd

Irrigation interval	IW/Epan (Amount of water, liter)		
	1	0.75	0.5
	Number of nodes/plant		
Daily	5.37c	9.0a	6.8bc
2 days	8.1ab	6.8bc	7.1abc
4 days	6.7bc	6.7bc	6.6bc
LSD at 5% = 1.905			

Although daily irrigation of moderate amount of water produced the highest number of nodes/plant, other biological characteristics of the plant remained statistically similar which implies that higher number of nodes per se does not guarantee the significant increase in crop yields and hence suggestion of daily irrigation might lead to decrease in water productivity.

None of the single effects of frequency and amount of irrigation had any significant effect on any of the response variables. Obviously, the question then turns to be why irrigation could not be effective to give rise to significant yield increase? A couple of related points could be worth explaining here without looking at the earlier findings.

One of the reasons that is thought to explain the non-significant effect of irrigation might be that seedling were transplanted by making 1' wide and sufficiently deep pits. As the plant grew, roots proliferated deeper into the loosened subsoil where they had greater probability to acquire easily relatively permanently stored sub-soil water even during dry season that cancelled the effect of applied water on the surface. Another reason could be that the fruits were harvested continuously for two months after irrigation was stopped in May 15, 1995. Weather data of growing season presented in Figure 1 indicated that as the irrigation was stopped, this was followed by a period that marked abrupt increase in rainfall that continued for two months until the end of July. It implied that as plots under all irrigation treatments started receiving the same amount of water whenever there was rain and none of the plots received irrigation when there was no rain because scheduled irrigation was already terminated with the onset of early monsoon. This weather condition might have muddled the treatment effect of irrigation. However, such reasoning might not be applicable in all cases. However, to be sure and to explain better about what might have been the effect for such result, similar experiment has to be repeated where crop is allowed to mature and harvested before the onset of monsoon season.

3.3 Performance of Lady's Finger

3.3.1 Crop Yield

Analysis of Variance (ANOVA) indicated that nitrogen as main plot factor had highly significant effect on yield of lady's finger (Table 5 and Annex 4).

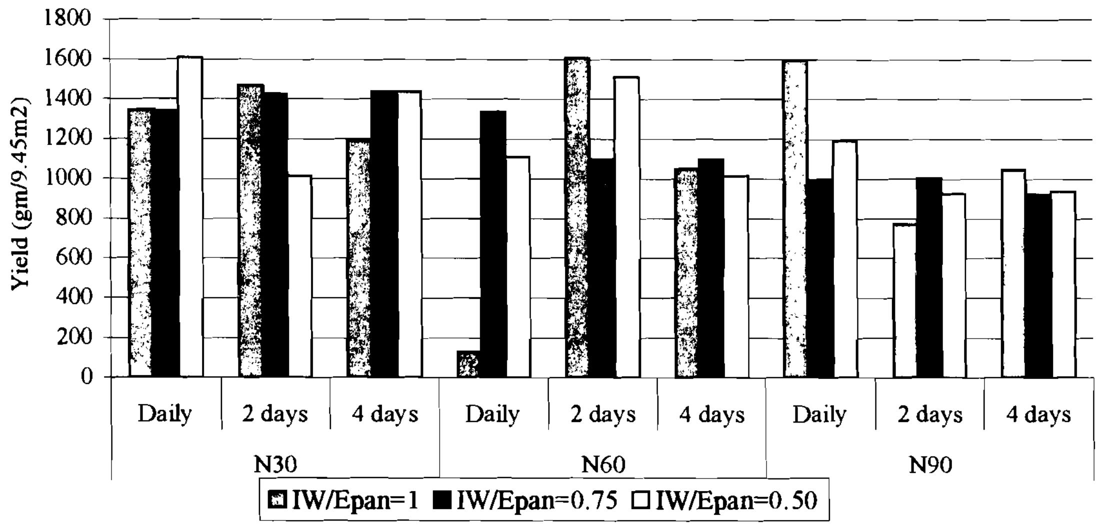
Table 5: Comparison of treatment means of interaction effect of nitrogen rate, irrigation interval and amount of water on the yield of lady's finger

Nitrogen (kg/ha)	Irrigation interval	IW/Epan (Amount of water, liter)		
		1	0.75	0.5
		Yield (gram/$2.8m^2$)		
N30	Daily	1345abcdefg	1341abcdefg	1609a
N30	2 days	1467abc	1425abcdef	1018defgh
N30	4 days	1196abcdefgh	1442abcd	1434abcde
N60	Daily	1305abcdefg	1335abcdefg	1112bcdefgh
N60	2 days	1610a	1098bcdefgh	1512ab
N60	4 days	1053cdefgh	1098bcdefgh	1015befgh
N90	Daily	1599a	995fgh	1189abcdefgh
N90	2 days	775h	1003efgh	928gh
N90	4 days	1045cdefgh	921gh	935gh
LSD at 5% = 434.4				

Although single effect of neither the frequency of irrigation at the sub-plot level nor the amount of irrigation at the sub-sub plot level could be observed significant on any of the response variables (Annex 4), yet there was significant interaction effect of nitrogen fertilizer, frequency and amount of water on crop yield (Annex 2 and Table 5). Nitrogen levels applied @30 and 60kg/ha had statistically similar effect than higher N level (90kg/ha) that produced rather lower yield (1043.7gm/sub-sub plot) (Annex 4).

A comparison of treatment means of interaction effect indicated that highest yield could be obtained by applying lowest water level (IW/Epan = 0.5) at wider time interval and keeping N level fairly low, i.e., 30kg/ha (Annex 4, Fig.3). Although highest yield was 1610g/$2.8m^2$ by applying highest level of water (IW/Epan = 1) and by raising N level from 30 to 60kg/ha, the mean yield values were statistically similar. The mean yield values in this table also suggested ways of nitrogen economy in lady's finger because higher N levels combined with different irrigation frequencies and amounts of water could not demonstrate statistically higher and superior yields compared with low N in combination with frequencies and amount of irrigation.

Fig.3 Effect of nitrogen rates, irrigation interval and amount of irrigation water on yield of lady's finger



Unlike the case of bottle gourd, it seems that the reason for significant interaction effect of N, frequency and amount of irrigation water on crop yield might be basically the difference in field preparation and not the treatment itself. In lady's finger, overnight soaked seeds were sown directly in the field without making pit that was practiced in bottle gourd. Because of existence of plow pan in Rampur soil, lady's finger plants grown on the loose shallow surface soils might have likely been influenced by added water because sub-surface stored water is not readily available unless it is broken through some means of sub-soiling.

4. SUMMARY

While irrigation has been recognized as a key production function for raising crop growth and productivity, effect of frequency and amount of irrigation as observed in this experiment did not produce statistically significant yields of bottle gourd. However, signs of yield increase were evident with these treatments but further study is warranted to quantify the appropriate amount and frequency of irrigation for producing significantly higher yield compared to control. On the one hand, mulch used as the main plot factor improved the performance of most of the attributes under consideration in these vegetables. But non-mulched plots, on the other, produced significantly more number of fruit bearing branches in bottle gourd. This indicated that mulching might not be necessary when irrigation is available at free or low cost to break dry season effect.

Lady's finger demonstrated highly significant yield increase with the lowest nitrogen level (30-60kg/ha), which might have been resulted due to a combination of higher residual soil nitrogen, organic matter content and efficient use of these when irrigation treatments removed the condition of moisture stress in the soil. Similarly, nitrogen as well as frequency and amount of irrigation interacted significantly and signaled that frequent but shallow irrigation would be more beneficial under similar soils and agro-ecological conditions of Rampur, Chitwan.

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Annex 1: Analysis of variance showing mean squares for yield and yield attributing characteristics of bottle gourd

Source of variance	DF	No. of fruits	No. of prim branches	No. of leaves	Avg. length	Avg. diameter	Days to 1st fem. flower	No. of nodes	Main shoot length	Yield
Replication	3	83.42	0.39	1416.46	113.30	0.62	19.35	7.22	9679.56	290.03
Mulching (A)	1	117.55 ns	0.89*	56.89 ns	37.08 ns	0.31 ns	5.56 ns	0.89 ns	460.05 ns	188.63 ns
Error (a)	3	45.52	0.037	2522.03	131.18	1.05	22.63	6.26	5262.87	100.55
Irri interval (B)	2	36.26 ns	2.76 ns	106.89 ns	17.23 ns	0.49 ns	5.01 ns	2.68 ns	898.09 ns	107.42 ns
A×B	2	149.01	1.35	890.05	9.68	0.39	6.43	0.09	4574.59	203.56
Error (b)	12	40.02	1.24	368.92	21.42	1.12	8.52	7.29	1272.03	72.13
Amt water (C)	2	15.84	0.43 ns	257.68 ns	11.41	0.28 ns	3.18 ns	4.35 ns	1608.93 ns	58.24 ns
A×B	2	92.68	0.35	1081.68	24.91	0.97	0.85	4.35	844.18	184.24
B×C	4	16.91	2.12	1091.85	69.93	0.62	10.05	12.86*	2582.47	54.85
A×B×C	4	34.70	1.49	257.09	2.53	0.27	3.47	0.87	2333.72	20.96
Error (C)	36	32.38	1.81	524.04	34.29	0.52	8.94	3.53	1101.62	60.95

*, Significant at 0.05 probability level, ns = non significant

Annex 2: Analysis of variance showing mean squares for yield and yield attributing characteristics of lady's finger.

Source of variance	DF	Yield	No. of fruits	Fruit length	Fruit girth	Plant height (cm)	Days to 50% flowering
Replication	3	1800056.16	46907.76	23.77	0.021	321.50	168.52
Mulching (A)	2	940486.0 **	24176.70 ns	1.23 ns	0.107 ns	334.23 ns	17.58 ns
Error (a)	6	74227.20	42266.49	2.76	0.035	157.13	47.17
Irrigation interval (B)	2	321407.95 ns	59671.56 ns	1.50 ns	0.011 ns	533.63 ns	22.53 ns
A×B	4	270129.55	58248.72	0.85	0.024	244.64	62.11
Error (b)	18	149344.45	40079.59	2.09	0.029	182.34	53.30
Amount of water (C)	2	71402.51 ns	1317.56 ns	0.83 ns	0.045 ns	78.17 ns	16.33 ns
A×B	4	50644.94	1273.47	0.84	0.006	47.34	21.67
B×C	4	54708.55	790.62	1.66	0.006	60.55	42.44
A×B×C	8	237489.56 *	1722.65	0.56	0.008	88.69	25.92
Error (C)	54	93914.00	775.62	1.04	0.019	61.68	16.95

*,** Significant at 0.05 and 0.01 probability level, respectively, ns = non significant

Annex 3: Effect of mulching, frequency of irrigation and amount of irrigation on yield and yield attributing characteristics of bottle gourd.

Treatments	No. of fruits	No. of primary branches	No. of leaves	Avg. fruit length	Avg. fruit diameter	Days to 1st fem. flowering	No. of nodes	Main shoot length (cm)	Yield (kg/sub-sub plot)
Mulching									
Mulching	17.14	3.25b	55.08	44.75	9.33	37.64	6.94	167.80	25.12
No Mulching	14.58	3.47a	53.30	46.18	9.46	37.08	7.17	162.75	21.88
SEM	1.12	0.03	8.37	1.90	0.17	0.79	0.42	12.09	1.67
CD at 5%	NS	0.204	NS	NS	NS	NS	NS	NS	NS
Irrig. interval									
Daily	16.75	3.75	54.58	45.47	9.23	37.0	7.08	172.33	25.79
2 days	14.45	3.20	56.08	44.61	9.90	37.20	7.37	162.04	21.62
4 days	16.37	3.12	51.92	46.31	9.47	37.87	6.70	161.46	23.09
SEM	1.29	0.32	3.92	0.94	0.21	0.59	0.55	7.28	1.37
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Amount of irrig									
IW/Epan=1	15.29	3.20	56.87	45.39	9.35	37.67	6.75	167.50	24.85
IW/Epan=0.75	15.50	3.42	55.17	44.82	9.32	37.46	7.54	172.12	21.80
IW/Epan=0.5	16.79	3.46	50.54	46.19	9.52	36.96	6.87	156.20	23.85
SEM	1.16	0.27	4.6	1.19	0.15	0.61	0.38	6.77	1.59
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS = Non-significant, S = Significant, HS = Highly significant

Annex 4: Effect of nitrogen rates, frequency of irrigation and amount of water on the yield and yield attributing characteristics of lady's finger.

Treatments	Yield (gm/ sub-subplot)	No. of fruits	Fruit length (cm).	Fruit girth (cm)	Plant height (cm)	Days to 50% flowering
Nitrogen (Kg/ha)						
N30	1364.55a	109.97	12.75	2.12	47.75	71.64
N60	1237.97a	98.53	12.53	2.04	52.84	72.80
N90	1043.67b	148.03	12.90	2.15	47.40	72.89
SEM	45.40	34.26	0.28	0.031	2.089	1.14
CD at 5%	157.1	NS	NS	NS	NS	NS
Irrig. interval						
Daily	1315.0	165.64	12.81	2.12	46.10	71.75

2 days	1204.17	99.33	12.88	2.09	53.59	72.28
4 days	1127.03	91.56	12.50	2.10	48.29	73.30
SEM	64.40	33.36	0.24	0.028	2.25	2.10
CD at 5%	NS	NS	NS	NS	NS	NS
Amount irrig						
IW/Epan=1	1266.47	124.08	12.72	2.14	47.71	71.67
IW/Epan=0.75	1184.67	112.22	12.58	0.07	49.67	72.83
IW/Epan=0.5	1195.05	120.22	12.88	2.11	50.60	72.83
SEM	51.07	4.64	0.17	0.023	1.30	0.68
CD at 5%	NS	NS	NS	NS	NS	NS

NS = Non-significant, S = Significant, HS = Highly significant